## HOUSTON COMMUNITY COLLEGE CENTRAL
### COURSE OUTLINE FOR CHEM 1412 – GENERAL CHEMISTRY II
#### Spring, 2017
Class Number 11374

<table>
<thead>
<tr>
<th>Discipline/Program</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Level</td>
<td>First Year (Freshman)</td>
</tr>
<tr>
<td>Course Title</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>Course Rubric and Number</td>
<td>CHEM 1412</td>
</tr>
<tr>
<td>Semester with Course Reference Number (CRN)</td>
<td>Spring 2017 CRN 11374</td>
</tr>
<tr>
<td>Course Location/Times</td>
<td>11:00 AM – 3:00 PM Tuesday (lecture, Room 408), &amp; Thursday (lab/lecture, Room 409) Central Campus</td>
</tr>
<tr>
<td>Course Semester Credit Hours (SCH) (lecture, lab)</td>
<td>4 (3 lecture, 3 lab)</td>
</tr>
<tr>
<td>Total Course Contact Hours</td>
<td>96</td>
</tr>
<tr>
<td>Course Length (number of weeks)</td>
<td>16</td>
</tr>
<tr>
<td>Type of Instruction</td>
<td>In-person</td>
</tr>
</tbody>
</table>
| Instructor contact information (phone number and email address) | Dr. John Goodwin  
Office Phone: (979) 492-5523  
E-mail: john.goodwin@hccs.edu  
Learning Web: http://learning.hccs.edu/faculty/john.goodwin |
| Office Location and Hours | 3:00 – 6:00 PM, Thu. @ the Learning Center (or, call or email) |
| Course Description: ACGM or WECM | General principles, problems, fundamental laws, and theories. Course content provides a foundation for work in advanced chemistry and related sciences. |
| Course Description: HCC Catalog Description | Science and engineering majors study atomic structure, chemical reactions, thermodynamics, electronic configuration, chemical bonding, molecular structure, gases, states of matter, and properties of solutions. Core Curriculum Course. Note: Only one of CHEM 1305, CHEM 1405, and/or CHEM 1411 can be used toward associate degree natural science requirements. Only one of the three will count as Natural Science core; the others may count as electives in the degree plan. |
| Course Prerequisite(s)   | One year of high school Chemistry; Must be placed into college-level reading (or take GUST 0342 as a co-requisite) and be placed into MATH 0312 (or higher) and be placed into college-level writing (or take ENGL 0310/0349 as a co-requisite). |
| Academic Discipline Program Learning Outcomes | 1. Distinguish between the different ways of measuring concentrations of solutions, and relate concentration to the colligative properties of solutions.  
2. Determine and analyze the rates of chemical reactions.  
3. Write equilibrium constant expressions for chemical reactions and calculate the value of the equilibrium constant and the concentration of reactants and products at equilibrium. |
4. Demonstrate proficiency in acid-base and solubility product calculations.
5. Express the three laws of thermodynamics and interrelate the enthalpy, free energy and equilibrium constant for the reaction.
6. Based on the principles of oxidation and reduction, balance oxidation-reduction reactions, calculate cell potentials of voltaic cells based on oxidation-reduction reactions, and make quantitative calculations based on electrolysis.
7. Identify modes of radioactive decay, balance nuclear reactions, calculate energy changes associated with nuclear reactions, and relate quantities of radioactive elements with time based on the kinetics of nuclear processes.
8. Classify, name, and draw the structure of basic organic compounds; student can write chemical reactions of alkanes, alkenes, and alkynes.

### Course Student Learning Outcomes (SLO)

1. Distinguish between the different ways of measuring concentrations of solutions, and relate concentration to the colligative properties of solutions.
2. Determine and analyze the rates of chemical reactions.
3. Write equilibrium constant expressions for chemical reactions and calculate the value of the equilibrium constant and the concentration of reactants and products at equilibrium.
4. Demonstrate proficiency in acid-base and solubility product calculations.
5. Express the three laws of thermodynamics and interrelate the enthalpy, free energy and equilibrium constant for the reaction.
6. Based on the principles of oxidation and reduction, balance oxidation-reduction reactions, calculate cell potentials of voltaic cells based on oxidation-reduction reactions, and make quantitative calculations based on electrolysis.
7. Identify modes of radioactive decay, balance nuclear reactions, calculate energy changes associated with nuclear reactions, and relate quantities of radioactive elements with time based on the kinetics of nuclear processes.
8. Classify, name, and draw the structure of basic organic compounds; student can write chemical reactions of alkanes, alkenes, and alkynes.

### Learning Objectives (Numbering system linked to SLO)

1.1. Relate the concentration of solutions to their colligative properties.
1.2. Determine if two compounds will mix to form a solution or not based on their structures.
1.3. Given the mass of a solute and the volume of a solution or the mass of the solvent, calculate the relevant concentration (molarity, molality, percent concentration, mole fraction, or ppm). Convert a given concentration from one concentration unit to another.
1.4. Determine the molecular weight of an unknown solute, given the value of a colligative property.
2.1. Determine the average rate and instantaneous rate of a reaction from
concentration-time data.

2.2. Determine the order of a reaction with respect to each reactant and write the rate law for the reaction. Determine the value of the rate constant, k.

2.3. Write the integrated rate law of first and second order reactions and use the rate law to relate concentration of the reactant with reaction time, rate constant, and half-life.

2.4. Given different initial reactant concentrations and the respective initial rate of the reaction, determine the value of the exponents in the rate law and the value of the rate constant.

2.5. Relate the effect of temperature and activation energy to reaction rate using the Arrhenius equation.

2.6. Relate the rate law to the mechanism of the reaction and to the molecularity of the elementary reactions comprising the mechanism.

3.1. Write the equilibrium constant expression for homogeneous and heterogeneous reactions.

3.2. Given one or more concentrations at equilibrium, calculate the value of the equilibrium constant for the reaction and/or the equilibrium concentrations of the other substances in the reaction.

3.3. Given one or more initial concentrations, calculate the concentrations of the reactants and products at equilibrium and/or the value of the equilibrium constant, using the "ICE" table method.

3.4. From the value of the reaction quotient, Q, determine whether a reaction is at equilibrium, and if not, which direction the reaction will initially proceed in order to reach equilibrium.

3.5. Apply LeChâtelier’s Principle to determine the effects of changes in concentrations, temperature on compositions of equilibrium mixtures.

4.1. Know the three different definitions and principles of acids and bases (Arrhenius, Bronsted-Lowry, and Lewis).

4.2. Calculate $[H^+]$, $[OH^-]$, pH, and pOH.

4.3. Use dissociation constants for weak monoprotic acids and bases to determine the pH of their aqueous solutions.

4.4. Differentiate between acidic, basic and neutral salts and determine the pH of aqueous solutions of salts.

4.5. Understand the common ion effect and its relevance to buffers;
determine the pH of buffered solutions using the Henderson-Hasselbalch equation.

4.6. Calculate the pH at various stages of titration curves for (i) strong acids & strong bases, (ii) weak acids & strong bases, (iii) strong acids & weak bases.

4.7. Write solubility product expressions and interconvert between the solubility constant, Ksp and concentrations of dissolved ions in saturated solutions of slightly soluble salts.

4.8. Given Ksp, determine whether precipitation will occur when two aqueous solutions of salts are mixed that react to form a sparingly soluble salt.

5.1. Express the concept of entropy and predict the sign of the entropy change for a given reaction.

5.2. Calculate the entropy change of a reaction using Hess’s law or standard entropies.

5.3. From the Gibbs equation, relate and calculate the values of the entropy, enthalpy, free energy, and temperature of a reaction.

5.4. Relate and calculate the value of the equilibrium constant to the entropy, enthalpy, free energy and temperature of the reaction.

6.1. Determine the oxidation state of elements in compounds.

6.2. Based on changes in oxidation states, determine which substance in a reaction is oxidized and which is reduced.

6.3. Balance oxidation-reduction reactions in acidic and basic solution using the method of half-reactions.

6.4. Sketch voltaic and electrolytic cells, identifying the anode, cathode, anode compartment, cathode compartment, salt bridge, and direction of electron flow.

6.5. Calculate standard cell potentials from standard reduction potentials.

6.6. Rank reducing agents and oxidizing agents based on standard reduction potentials.

6.7. Determine non-standard cell potentials from standard cell potentials using the Nernst equation.

6.8. Interconvert between time, current, and masses of reactants and
products in electrolysis processes.

7.1. Identify common modes of radioactive decay.

7.2. Write balanced nuclear reactions.

7.3. Differentiate between the different modes of decay and predict the likely mode of decay.

7.4. Interconvert between rates of nuclear decay, half-lives of radioactive nuclei, and amounts of radioactive nuclei.

7.5. Determine energy changes of nuclear reactions and stability of nuclei using Einstein’s equation.

7.6. Distinguish between subcritical, critical, and supercritical masses; contrast nuclear fission with nuclear fusion processes.

7.7. Identify the major components and principle of operation of nuclear reactors.

8.1. Given the structure, name alkanes using the IUPAC rules of nomenclature, and vice-versa.

8.2. Classify organic compounds based on the functional group present in their structures.

8.3. Given the structure, name alkenes and alkynes using the IUPAC rules of nomenclature, and vice-versa.

8.4. Optional if time permits. Write combustion and halogenation reactions of alkanes; write addition reactions of alkenes and alkynes

<table>
<thead>
<tr>
<th>SCANS and/or Core Curriculum Competencies</th>
<th>Reading, Speaking/Listening, Critical Thinking, Computer/Information Literacy</th>
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</thead>
<tbody>
<tr>
<td>EGLS: Evaluation of Greater Learning Student Survey</td>
<td>At Houston Community College, professors believe that thoughtful student feedback is necessary to improve teaching and learning. During a designated time, you will be asked to answer a short online survey of research-based questions related to instruction. The anonymous results of the survey will be made available to your professors and division chairs for continual improvement of instruction. Look for the survey as part of the Houston Community College Student System online near the end of the term.</td>
</tr>
<tr>
<td>Course Calendar</td>
<td>Tentative Course Schedule (subject to change):</td>
</tr>
</tbody>
</table>

*Please look over the lab and the pre-lab questions prior to coming to the lab, on days of experiments. The {pre-lab+report+post-lab} will be due on the date of the next lab experiment, at the beginning of lab.*


Feb. 28: Begin Chapter 15.
Mar. 2: Conclude Chapter 15. Expt. 4: Kinetics of a chemical reaction.

Mar. 7: Exam I – Chapters 13, 14 and 15.
Mar. 9: Begin Chapter 16. Expt. 6: Acid/base titration: Determine the purity of KHP.

Mon., 13 Mar. - Sunday, 19 Mar.: Spring Break - no classes.

Mar. 21: Conclude Chapter 16.

Mar. 28: Continue Chapter 17.

APRIL 11: LAST DAY TO WITHDRAW (BEFORE 4:30 PM) with a grade of W
Apr. 4: **Exam II – Chapters 16 and 17.**
Apr. 6: Begin **Chapter 19. Expt. 13:** Electrochemistry: New, used & rechargeable batteries.

Apr. 11: Conclude **Chapter 19. LAST DAY TO WITHDRAW.**
Apr. 13: Begin **Chapter 20. Expt. 15:** Structural formulae and isomerism.

Apr. 18: Continue **Chapter 20.**
Apr. 20: Conclude **Chapter 20. Expt. 18:** Preparation of aspirin/UV-Vis.

Apr. 25: **Exam III: Chapters 19 & 20.**

May 2: Conclude **Chapter 21; begin Chapter 24.**
May 4: Conclude Chapter 24; **Expt. 16*: FT-IR Spectroscopy** (*equipment permitting).

May 9: **Exam IV: Chapters 21 & 24.**
May 11: **Comprehensive (chapters 13-17, 19-21 & 24) Final Exam (11:00 AM; room 408 or 409).**

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**Instructional Methods**
Class lectures using the whiteboard and power point presentations.

**Student Assignments**
Outside of laboratory reports, special assignments are normally not required. I will recommend practice problems but these are not graded. Practice problems, such as those at the end of the chapters, are highly beneficial, indeed essential, to learning chemistry. I recommend that you work as many of the even-numbered end of chapter problems as you can (these have answers in the back of your textbook); similar additional problems follow in the “Additional Problems” section. Get a spiral leaf notebook just for working chemistry problems. That will keep your work more organized and you (or I) can easily review your work.

**Student Assessment(s)**
The overall score is based on the following:
- Top 3 regular exams: 51%
- Homework (3%) and quizzes (6%) = 9%
- Laboratory: 20%
- Final Exam: 20%

**Instructor’s Requirements**
**Laboratory Policy**
Lab safety will be reviewed before the first lab. Each student will then sign a statement affirming his or her commitment to following safe procedures in the laboratory, and turn the form in to the instructor. Be especially aware of
the need for adequate eye protection and proper dress in the laboratory. Safety glasses or goggles must be worn at all times during the laboratory period. Normally, experiments will be performed in groups of two students. Students should arrive at the lab on time with their lab manual. After you have finished the experiment, show me your results for me to examine briefly, and I will initial your lab report before you leave. Laboratory reports are due on the next lab day. Each report must be done individually, but of course you can work with your lab partners on it. Each report will be graded on a 100-point basis. Come to lab prepared. Read through the experiment beforehand and do the pre-lab questions at the end of the lab report. You will be much better organized when doing the experiments, and your laboratory experience will be much more rewarding.

**Exams and Make-up Policy**
Examinations will consist of four non-cumulative regular exams (51%), periodic quizzes (6%) and a comprehensive final (20%). Programmable calculators, such as the TI 83 Plus, are not allowed during exams. The department has calculators that you can use on test days if you do not have a “regular” calculator. Make-up exams will not normally be given, so make every effort to take the exams on their scheduled dates. The three highest exam scores will be counted towards your final average. If you miss an exam, that will count as your dropped exam score. Remember that the final exam will be comprehensive (meaning that it will cover all of the material from the whole semester, not just the last part). Please note that all students are required to take the final (no student can be exempted).

**Program/Discipline Requirements**
At the program level, the Chemistry Discipline strives to accomplish the Program Learning Outcomes, Student Learning Outcomes, and Learning Objectives as described above. We desire that you receive a challenging and rewarding experience in your chemistry classes at HCC which will prepare you well for future chemistry and related science courses that you may take in the future.

**HCC Grading Scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points per Semester Hour</th>
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</thead>
<tbody>
<tr>
<td>A = 100 – 90:</td>
<td>4 points per semester hour</td>
</tr>
<tr>
<td>B = 89 – 80:</td>
<td>3 points per semester hour</td>
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<tr>
<td>C = 79 – 70:</td>
<td>2 points per semester hour</td>
</tr>
<tr>
<td>D = 69 – 60:</td>
<td>1 point per semester hour</td>
</tr>
<tr>
<td>59 and below = F</td>
<td>0 points per semester hour</td>
</tr>
<tr>
<td>IP (In Progress)</td>
<td>0 points per semester hour</td>
</tr>
<tr>
<td>W (Withdrawn)</td>
<td>0 points per semester hour</td>
</tr>
<tr>
<td>I (Incomplete)</td>
<td>0 points per semester hour</td>
</tr>
<tr>
<td>AUD (Audit)</td>
<td>0 points per semester hour</td>
</tr>
</tbody>
</table>

IP (In Progress) is given only in certain developmental courses. The student must re-enroll to receive credit. COM (Completed) is given in non-credit
and continuing education courses. To compute grade point average (GPA), divide the total grade points by the total number of semester hours attempted. The grades “IP,” “COM” and “I” do not affect GPA.

<table>
<thead>
<tr>
<th>Instructor Grading Criteria</th>
<th>See the above descriptions of the lab, exams, quizzes, and final. The course grade is based on these four criteria according to the Assessment section above.</th>
</tr>
</thead>
</table>
| Instructional Materials     | **Textbooks:** Chemistry, The Central Science, 13th Edition by Brown and Lemay  
**Chemistry: The Central Science (Volume 2)**  
**Custom Package for Houston Community College**  
**Laboratory Manual for CHEM 1412**,  
**Disability Support Services (DSS)**  
“Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Disability Services Office at the respective college at the beginning of each semester. Faculty are authorized to provide only the accommodations requested by the Disability Support Services Office.”  
If you have any special needs or disabilities which may affect your ability to succeed in college classes or participate in any college programs or activities, please contact the DSS office for assistance. At Southwest College, contact Dr. Becky Hauri, 713-718-7909. Contact numbers for the other HCC colleges are found in the Annual Schedule of Classes, and more information is posted at the HCC web site at [Disability Services](http://hccs.edu/student-rights).  
**Academic Honesty**  
“Students are responsible for conducting themselves with honor and integrity in fulfilling course requirements. Disciplinary proceedings may be initiated by the college system against a student accused of scholastic dishonesty.
These may result in failure of the course, academic probation, or even dismissal from the college. Scholastic dishonesty includes, but is not limited to, cheating on a test, plagiarism, and collusion.” In this class, the penalty for willful cheating on exams is a grade of F in the course. This is the standard policy of the Physical Sciences department at Southwest College.

**Attendance Policy**
The HCCS attendance policy is stated as follows: “Students are expected to attend classes regularly. Students are responsible for materials covered during their absences, and it is the student’s responsibility to consult with instructors for make-up assignments. Class attendance is checked daily by instructors. Although it is the responsibility of the student to drop a course for non-attendance, the instructor has full authority to drop a student for excessive absences. A student may be dropped from a course for excessive absences after the student has accumulated absences in excess of 12.5% of the hours of instruction (including lecture and laboratory time).”

Note that 12.5% is approximately 4 classes or labs for a 4 semester hour course, such as this one, which meets 2 times per week in a 16 week semester. If circumstances significantly prevent you from attending classes, please inform me. I realize that sometimes outside circumstances can interfere with school, and I will try to be as accommodating as possible, but please be aware of the attendance policy.

**Policy Regarding Multiple Repeats of a Course**
“NOTICE: Students who repeat a course three or more times may soon face significant tuition/fee increases at HCC and other Texas public colleges and universities. If you are considering course withdrawal because you are not earning passing grades, confer with your instructor/counselor as early as possible about your study habits, reading and writing homework, test-taking skills, attendance, course participation, and opportunities for tutoring or other assistance that might be available.”

**Last Day for Administrative and Student Withdrawals**
For 16-week Fall classes, this date is **April 11**. I urge any student who is contemplating withdrawing from the class to see me first! I want to be accessible and supportive. I do not believe in “weed out” classes, and I consider you to be much more than just a name or number! Note my office hours above; if you need assistance, I'm here to help.

**Policy Regarding Withdrawals**
Students desiring to withdraw from a class must do so by the above withdrawal date by filling out a withdrawal form at the registrar’s office. After this date, instructors can no longer enter a grade of “W” for the course for any reason.
Title IX statement: “HCC is committed to providing a learning environment that is free from sex discrimination; this includes all forms of sexual misconduct. Title IX of the 1972 education amendment requires a prompt, thorough investigation when a complaint is filed. Complaints may be filed with the HCC Title IX coordinator, available at (713) 718-8271, or at email address oie@hccs.edu.”

Class disruption statement: ‘We are committed to providing a learning environment that is free from classroom disruptions. A student’s interference with classroom instruction, through talking, making noise or causing other disruptive activity -as identified by the instructor- will not be tolerated. If the instructor finds that a student continues to be disruptive, after one or two warnings, the student may be asked to leave the classroom. Should this occur, the student will not be allowed back into the classroom unless he or she initiates contact with the instructor, either in person or via telephone or email, asking to be reinstated in the class. Failure to request reinstatement in the class will, after the maximum number of absences as mentioned above, result in the student’s being dropped from the class rolls.’

<table>
<thead>
<tr>
<th>Distance Education and/or Continuing Education Policies</th>
<th>Access DE Policies on their Web site: <a href="http://de.hccs.edu/Distance_Ed/DE_Home/faculty_resources/PDFs/DE_Syllabus.pdf">http://de.hccs.edu/Distance_Ed/DE_Home/faculty_resources/PDFs/DE_Syllabus.pdf</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Access CE Policies on their Web site: <a href="http://hccs.edu/CE-student-guidelines">http://hccs.edu/CE-student-guidelines</a></td>
<td></td>
</tr>
<tr>
<td>Test Bank</td>
<td>NA</td>
</tr>
<tr>
<td>Scoring Rubrics</td>
<td>Regular exams and the final will consist of multiple-choice and show-work questions. These are graded in the standard manner. The regular exams may include an extra question for extra credit, for a total possible score of about 105 points. The lab reports are graded on the basis of completeness, neatness, &amp; correctness of the calculations tied to the experimental result. The pre- and &amp; post-lab questions are also checked. Each report is graded on a 100-point basis.</td>
</tr>
<tr>
<td>Sample Assignments</td>
<td>NA</td>
</tr>
<tr>
<td>Sample Instructional Methods/Activities</td>
<td>NA</td>
</tr>
</tbody>
</table>