SYLLABUS FORM
WESTCHESTER COMMUNITY COLLEGE
Valhalla, NY 10595

1. CURRENT DATE:  Spring 2015
   Please indicate whether this is a NEW COURSE or a REVISION:  Revision

   DATE OF PRIOR REVISION:  Spring 2012

2. NAME OF REVISER:  Dr. Jody Reifenberg

3. COURSE #:  CHEM 107

4. NAME OF COURSE:  Inorganic Chemistry 1 - Lecture & Lab

5. COURSE DESCRIPTION:

   CHEM 107    Inorganic Chemistry 1 - Lecture & Lab
   5 credits

   In-depth study of matter, the mole concept, composition & reaction stoichiometry, chemical reaction types, solution stoichiometry, thermochemistry, atomic structure, quantum theory, chemical periodicity, chemical bonding models, molecular structure, and the properties of gases, liquids & solids. Laboratory experiments emphasize quantitative analytical techniques.

   Notes:  Inorganic Chemistry 1 is the first semester of a one-year (two-semester) comprehensive general chemistry course designed for science or engineering majors transferring to a four-year college or for students fulfilling prerequisites for medical school or related programs. Class Hours: 4; Lab Hours: 3; Prerequisites: MATH 130 (College Algebra: Functions & Models) OR MATH 135 (College Algebra with Trigonometry) OR higher level math; Offered in Fall and Spring semesters and Summer Session 1.

6. NUMBER OF CREDITS:  5 credits

7. NUMBER OF CONTACT HOURS PER WEEK
   a. Lab hours:  3   b. Lecture hours:  4

8. APPROXIMATE FREQUENCY OF OFFERING THIS COURSE:  Fall, Spring and Summer Session I.

9. PREREQUISITES:  MATH 130 (College Algebra: Functions & Models) OR MATH 135 (College Algebra with Trigonometry) OR higher level math

10. COREQUISITES:  None

11. ASSOCIATED COURSES:  None

12. PLACE OF THIS COURSE IN CURRICULUM:  Required for Curriculum: Liberal Arts/Math & Science; Part of required/recommended sequence with CHEM 111.

13. ADDITIONAL COMMENTS/CLASS NOTES:  Students must register for both a lecture and lab section.
14. REQUIRED TEXTS AND/OR MATERIALS ¹:
   
   
   

¹Textbooks are subject to change each semester. For updated textbook requirements, please contact the WCC Bookstore.

15. STUDENT LEARNING OUTCOMES (SLOs) and COURSE OBJECTIVES:

<table>
<thead>
<tr>
<th>SLO/Objectives* - Upon successful completion, the student will be able to:</th>
<th>This outcome will be measured* by one or more of the following instruments (exercises, tools, observations):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture</strong>- SLO 1: apply an in-depth knowledge of the molecular nature of matter and its relationship with energy to quantify the changes in chemical composition and energy that take place during a chemical reaction.</td>
<td><strong>Lecture</strong>- Measure 1: SLO 1 and its objectives will be primarily measured by Exam 1, Exam 2 and the Final Exam.</td>
</tr>
<tr>
<td><strong>Objective 1</strong>: demonstrate an understanding of the concept of the mole and perform the related calculations involving the mole concept.</td>
<td><strong>Note about Lecture Measures</strong>: In lecture, examinations for the most part, will consist of calculation and qualitative reasoning problems which require the student to show all relevant calculations and support work in a clear and organized progression leading to the final answer. Questions will emphasize conceptual understanding rather than rote memorization. Use of a systematic and logical approach to problem solving will be a key factor in assessment. Some concepts may also be tested using a short essay or multiple choice format. Additional methods of assessment in lecture may include: (i) student performance on homework assignments and/or quizzes and (ii) the level and extent of class participation.</td>
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<td><strong>Objective 2</strong>: balance chemical equations and demonstrate an understanding of the qualitative and quantitative information balanced equations provide.</td>
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<tr>
<td><strong>Objective 3</strong>: apply one’s knowledge of moles and chemical reactions to perform stoichiometric calculations including those involving formula determination, percent composition by mass, reaction stoichiometry and limiting &amp; excess reactants.</td>
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<tr>
<td><strong>Objective 4</strong>: describe the fundamental concepts and laws of thermochemistry that dictate the flow of heat during a chemical reaction and employ these principles to quantify the heat transfer that takes place during a chemical reaction.</td>
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<tr>
<td><strong>SLO 2</strong>: demonstrate a comprehensive understanding of the properties of aqueous solutions and gases, and apply this knowledge to perform stoichiometric calculations involving aqueous and gaseous reactions.</td>
<td><strong>Measure 2</strong>: SLO 2 and its objectives will be primarily measured by Exam 2, Exam 3 and the Final Exam.</td>
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<tr>
<td><strong>Objective 1</strong>: characterize the different classes of chemical reactions that occur in aqueous solution.</td>
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<tr>
<td><strong>Objective 2</strong>: express the concentration of solutions in terms of molarity and perform the associated calculations including those involving dilution, the preparation of solutions and solution stoichiometry.</td>
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<tr>
<td><strong>Objective 3</strong>: demonstrate an understanding of the properties and laws that govern ideal and real gases.</td>
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<tr>
<td><strong>Objective 4</strong>: apply the appropriate gas law(s) to solve problems involving changes in the conditions of a gas, gas stoichiometry, gas mixtures, gas density and molar mass.</td>
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<tr>
<td><strong>Objective 5</strong>: describe the postulates of the kinetic molecular theory of gases and explain how this model accounts for the qualitative and quantitative aspects of gas behavior.</td>
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</tbody>
</table>
15. STUDENT LEARNING OUTCOMES (SLOs) and COURSE OBJECTIVES (CONTINUED):

<table>
<thead>
<tr>
<th>SLO/Objectives *- Upon successful completion, the student will be able to:</th>
<th>This outcome will be measured* by one or more of the following instruments (exercises, tools, observations):</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture (continued)</strong>- SLO 3: apply atomic theory and molecular bonding concepts to understand and predict molecular structure and the properties of compounds.</td>
<td><strong>Lecture (continued)</strong>- Measure 3: SLO 3 and its objectives will be primarily measured by Exam 4 and the Final Exam.</td>
</tr>
<tr>
<td><strong>Objective 1:</strong> describe the Bohr model of the hydrogen atom, including its strengths, weaknesses, how this model explains the atomic emission spectrum of hydrogen and correctly fits the quantized energy levels of the hydrogen atom.</td>
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<tr>
<td><strong>Objective 2:</strong> describe the evolution of atomic theory from earlier models of the atom to the modern-day quantum mechanical view of an atom.</td>
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<tr>
<td><strong>Objective 3:</strong> demonstrate an understanding of the quantum mechanical model of the atom and explain how this model accounts for the arrangement of the elements in the periodic table and the observed trends in the atomic properties of these elements.</td>
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<tr>
<td><strong>Objective 4:</strong> describe the various models of chemical bonding and use these bonding models to predict the geometry and properties of molecules.</td>
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<tr>
<td><strong>Objective 5:</strong> predict the intermolecular forces of attraction that exist among molecules in the liquid and solid states and explain how these attractive forces account for differences in the properties and phase changes of these substances.</td>
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<tr>
<td><strong>Lab</strong>- SLO 4: demonstrate proficiency in performing standard chemical laboratory techniques in accordance with proper safety procedures, and analyze data through the application of mathematics, graphical techniques and deductive reasoning to reach logical conclusions about chemical phenomena.</td>
<td><strong>Lab</strong>- Measure 4: SLO 4 and its objectives will be measured by student performance on laboratory reports, lab quizzes/examinations and practical assessments of laboratory techniques.</td>
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<tr>
<td><strong>Objective 1:</strong> demonstrate the ability to properly use basic laboratory instruments and wet chemistry procedures to obtain accurate data.</td>
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<tr>
<td><strong>Objective 2:</strong> critically analyze experimental data through the employment of mathematics, graphical procedures and logical deduction to arrive at reasonable conclusions that reinforce an understanding of the chemical concepts discussed in lecture.</td>
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<tr>
<td><strong>Objective 3:</strong> perform a comprehensive error analysis of experimental results and identify potential sources of error to account for deviations from accepted values.</td>
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<td><strong>Objective 4:</strong> communicate experimental findings in a clear and logical manner.</td>
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<tr>
<td><strong>Objective 5:</strong> demonstrate an understanding of the ethical and safety protocols involved in chemistry laboratory work.</td>
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</table>

*Variations from this basic plan may occur depending on the individual instructor teaching the course and/or the time constraints of a given semester.*
### SUNY General Education Outcomes (Appendix A)

<table>
<thead>
<tr>
<th>Natural Sciences - Students will demonstrate:</th>
<th>Related Course SLO and Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>understanding of the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis.</td>
<td>SLO 4 and Measure 4</td>
</tr>
<tr>
<td>application of scientific data, concepts, and models in one of the natural (or physical) sciences.</td>
<td>SLOs 1, 2 &amp; 3 and Measures 1, 2 &amp; 3</td>
</tr>
</tbody>
</table>

16. **COURSE GRADING CRITERIA:**

   **Lecture** \(^1\) = 75% (of final grade)
   In lecture, students are evaluated on the basis of their performance on the class examinations (typically four 50-minute exams) and the comprehensive final exam (~100 to 150 minutes). Some instructors may also choose to use additional quizzes, homework and/or extra-credit assignments to evaluate students. Additionally, attendance may be used as a factor in determining the lecture average.

   **Lab** \(^1,2\) = 25% (of final grade)
   In lab, students are evaluated on the basis of their performance on the lab reports, quizzes and the final exam. Some instructors may also choose to use assessments of lab technique and/or lab preparedness as additional factors in determining the lab average.

1 Variations from this basic plan may occur depending on the instructor. Instructors will state their grading procedures at the start of the term.

2 Exception: Students who fail the lab will fail the course regardless of their lecture average.

17. **INSTRUCTIONAL METHODS:** List the different instructional methods you might use, in the course of the semester. List supplementary learning options, if any:

   - Lecture and laboratory lessons involving extensive board work and class participation.
   - Use of Smart Boards for internet access and PowerPoint presentations in the classroom and the lab.
   - Incorporation of problem-solving throughout lecture and laboratory discussions to reinforce and apply theoretical concepts.
   - Use of Blackboard as an online learning platform to supplement lectures and labs.
   - Daily homework assignments, assigned from the textbook and/or from assignment sheets prepared by the instructor.
   - Laboratory demonstrations performed by the instructor at the beginning of each lab session, illustrating proper performance of lab techniques, correct usage of instruments and assembly of equipment.
   - Extensive hands-on laboratory experience.
   - Optional review sessions led by the instructor.
   - Office hours to provide students with opportunities for one-to-one help.

18. **TOPIC OUTLINE:** Please see following pages.

19. **UNIQUE ASPECTS OF COURSE** (such as equipment, specified software, space requirements, etc.):
   Chemistry laboratories and their associated equipment, instruments and chemicals.
CHEM 107 Lecture Topic Outline*

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topics</th>
</tr>
</thead>
</table>
| 1    | **Foundations of Chemistry**  
  - Units of measurement, Dimensional analysis, Significant figures, Density  
  - Classification and properties of matter, Elements and compounds, Mixtures, Chemical and physical changes |
| 2    | **Atoms, Molecules and the Mole Concept**  
  - Dalton's atomic theory, Early atomic structure experiments, Nuclear atom, Isotopes, Molecules, Ions  
  - Introduction to the periodic table, Isotope symbols, Chemical formulas  
  - Atomic mass, Mass spectrometer, Average atomic mass, Mass defect  
  - Mole concept and related calculations |
| 3 - 5 | **Stoichiometry and Chemical Reactions**  
  - Determination of empirical and molecular formulas, Percent composition by mass, Balancing chemical equations  
  - Reaction stoichiometry, Limiting & excess reactants, Percent yield  
  - Aqueous solutions, Molarity, Dilution, Preparation of solutions, Classes of chemical reactions  
  - Solution stoichiometry |
| 6, 7 | **Gases**  
  - Gas pressure, Manometers, Boyle's law, Charles's law, Concept of absolute zero, Gay-Lussac's law, Combined gas law, Avogadro's law, Ideal gas law, Molar volume, Gas density, Molar mass of a gas, Gas stoichiometry  
  - Gas mixtures, Dalton's law of partial pressures, Mole fraction of a gas, Collecting a gas over water  
  - Kinetic molecular theory of gases, Effusion and diffusion, Real gases |
| 8    | **Thermochemistry**  
  - First law of thermodynamics, Heat, Work, Internal energy changes, Calorimetry, Hess's law  
  - Enthalpy change for reactions from standard enthalpies of formation |
| 9, 10 | **Atomic Structure and Quantum Theory**  
  - Electromagnetic radiation, Calculations of photon energy and wave properties, Atomic spectra, Bohr model  
  - Energy quantization calculations in hydrogen  
  - Quantum mechanical model of an atom, Dual nature of the electron, Quantum numbers, Shapes and energies of atomic orbitals, Pauli exclusion principle  
  - Aufbau principle, Electron configurations of atoms and the periodic table, Hund's rule, Orbital diagrams, Exceptions to electron configurations |
| 11   | **Chemical Periodicity**  
  - Periodic trends in atomic properties including atomic radius, ionization energy and electron affinity  
  - Successive ionization energies  
  - Prediction of ionic charge for representative-group elements, Electron configurations of ions, Isoelectronic ions, Size of ions |
| 12-14 | **Chemical Bonding Models and Molecular Structure**  
  - Ionic bonds, Ionic compounds, Prediction of ionic formulas, Lattice energy  
  - Covalent bonds, Covalent compounds, Lewis structures of molecules & polyatomic ions, Exceptions to octet rule  
  - Resonance, Bond properties including bond length, bond energy & vibrational frequency and their dependence on bond order, Enthalpy change for reactions from bond energies, Electronegativity, Bond polarity  
  - VSEPR model, Prediction of molecular & ionic structure, Polarity of molecules and effect on solubility  
  - Hybrid orbitals and other bonding/orbital models, Hydrocarbons, Isomerism |
| 15   | **Liquids and Solids**  
  - Intermolecular forces of attraction including dipole-dipole forces, hydrogen bonding, & London dispersion forces  
  - Effect of attractive forces on the properties of liquids and solids including vapor pressure, boiling point & melting point  
  - Overview of the structures and types of solids  
  - Phase changes, Phase diagrams |

*Exact topic content and time allotted to topics will depend on the individual instructor and/or the time constraints of a given semester.

(CHEM 107 syllabus continued on next page)
<table>
<thead>
<tr>
<th>Week</th>
<th>Experiment**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, Check-in, Safety, Rules of Significant Figures</td>
</tr>
<tr>
<td>2</td>
<td>Determination of the Density of a Metal</td>
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<td>3</td>
<td>Determination of the Formula of a Hydrate</td>
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<tr>
<td>4</td>
<td>Determination of the % Sulfate in K₂SO₄: A Gravimetric Technique</td>
</tr>
<tr>
<td>5</td>
<td>Determination of the Empirical Formula of a Compound: Synthesis of Copper Sulfide</td>
</tr>
<tr>
<td>6</td>
<td>The Determination of the Concentration of Acetic Acid in Vinegar</td>
</tr>
<tr>
<td>7</td>
<td>Molecular Weight by Vapor Density</td>
</tr>
<tr>
<td>8</td>
<td>The Molar Volume of a Gas at STP</td>
</tr>
<tr>
<td>9</td>
<td>A Study of Chemical Reactions and the Periodic Table</td>
</tr>
<tr>
<td>10</td>
<td>Double Replacement Reactions</td>
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<tr>
<td>11</td>
<td>Heats of Reaction</td>
</tr>
<tr>
<td>12</td>
<td>Organic Chemistry: A Study of Hydrocarbons and Isomerism</td>
</tr>
<tr>
<td>13</td>
<td>Determination of the Alcohol Content in Beer: A Distillation</td>
</tr>
<tr>
<td>14</td>
<td>The Effect of Temperature on Solubility of a Salt</td>
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<tr>
<td>15</td>
<td>Check-out, Laboratory Final Exam</td>
</tr>
</tbody>
</table>

*The laboratory schedule is subject to change depending on the individual instructor and/or the time constraints of a given semester.

**Chemical nomenclature is a topic covered fully in lab. Every lab session will include a component devoted to teaching and practicing nomenclature.
APPENDIX A
SUNY GENERAL EDUCATION KNOWLEDGE AND SKILL AREAS

1. MATHEMATICS - Students will demonstrate the ability to:
   • interpret and draw inferences from mathematical models such as formulas, graphs, tables and schematics;
   • represent mathematical information symbolically, visually, numerically and verbally;
   • employ quantitative methods such as, arithmetic, algebra, geometry, or statistics to solve problems;
   • estimate and check mathematical results for reasonableness; and
   • recognize the limits of mathematical and statistical methods.

2. NATURAL SCIENCES - Students will demonstrate:
   • understanding of the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis; and
   • application of scientific data, concepts, and models in one of the natural (or physical) sciences.

3. SOCIAL SCIENCES - Students will demonstrate:
   • understanding of the methods social scientists use to explore social phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical and interpretive analysis; and
   • knowledge of major concepts, models and issues of at least one discipline in the social sciences.

4. AMERICAN HISTORY - Students will demonstrate:
   • knowledge of a basic narrative of American history: political, economic, social, and cultural, including knowledge of unity and diversity in American society;
   • knowledge of common institutions in American society and how they have affected different groups; and
   • understanding of America's evolving relationship with the rest of the world.

5. WESTERN CIVILIZATION - Students will:
   • demonstrate knowledge of the development of the distinctive features of the history, institutions, economy, society, culture, etc., of Western civilization; and
   • relate the development of Western civilization to that of other regions of the world.

6. OTHER WORLD CIVILIZATIONS - Students will demonstrate:
   • knowledge of either a broad outline of world history, or
   • the distinctive features of the history, institutions, economy, society, culture, etc., of one non-Western civilization.

7. HUMANITIES - Students will demonstrate:
   • knowledge of the conventions and methods of at least one of the humanities in addition to those encompassed by other knowledge areas required by the General Education program.

8. THE ARTS - Students will demonstrate:
   • understanding of at least one principal form of artistic expression and the creative process inherent therein.

9. FOREIGN LANGUAGE - Students will demonstrate:
   • basic proficiency in the understanding and use of a foreign language; and knowledge of the distinctive features of culture(s) associated with the language they are studying.

10. BASIC COMMUNICATION - Students will:
    • produce coherent texts within common college-level written forms;
    • demonstrate the ability to revise and improve such texts;
    • research a topic, develop an argument, and organize supporting details;
    • develop proficiency in oral discourse; and
    • evaluate an oral presentation according to established criteria.