



## **CHEM 111/L111 M1 - GENERAL CHEMISTRY I with LAB**

### **Instructor Information:**

**Instructor:** Carl-Gustaf Pierre Saluste, PhD

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### **Course Information:**

**Catalog Description:** Fundamental principles of chemistry are discussed. Topics include introductions to atomic structure, stoichiometry, periodic table, gas laws, nature of chemical bonds, and thermochemistry. This course is recommended for science and engineering majors or those considering careers in the health sciences.

**Prerequisites:** We will use math to solve chemical problems throughout this course. Minimally, you should have credit for MATH 104 (or a higher MATH course) or be concurrently enrolled in MATH 104.

**Credit Hours:** 4

This course follows the US Federal Government's Credit Hour definition: "An amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutional established equivalence that reasonably approximates no less than:

- (1) One hour of classroom or direct faculty instruction and a minimum of two hours of out of class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or
- (2) At least an equivalent amount of work as required in paragraph (1) of this definition for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours."

For full up-to-date statement:

[https://cihe.neasc.org/sites/cihe.neasc.org/files/downloads/POLICIES/Pp111\\_Policy\\_On\\_Credits-And-Degrees.pdf](https://cihe.neasc.org/sites/cihe.neasc.org/files/downloads/POLICIES/Pp111_Policy_On_Credits-And-Degrees.pdf)

A more detailed breakdown of the student engagement is given below:

<b>Assignment</b>	<b>Engagement Estimate</b>	<b>Engagement Hours</b>
Course readings	400 pages x 8 min/page	40
Homework	7 assignments x 2 h/assignment	14
Review of PPt-presentations	10 PPt x 30 min / PPt	6
Preparation of lab reports	20 h preparation	20
Midterm exam	8 h preparation	8
Final exam	15 h preparation	15
Class attendance	3h x 15 weeks	45
Lab attendance	3 h x 10 weeks	30
<b>ESTIMATED TOTAL</b>		<b>178 HOURS</b>

**Textbook/Course Materials:**

"Chemistry, Structure and Properties" (custom version for Suffolk University) by Nivaldo J. Tro (ISBN: 978-0-321-83468-3).

Also keep in mind the library collection of books related with basic Chemistry.

Homework problems and exams will require the use of a scientific calculator.

**Course Goals & Learning Objectives:**

<b>Upon successful completion of this course, students will:</b>	<b>Upon successful completion of this course, students will be able to:</b>	<b>How the student will be assessed on these learning objectives:</b>
<ul style="list-style-type: none"> <li>Understand that the STE disciplines involve a manner of inquiry and a process, and are not just content.</li> </ul>	<ul style="list-style-type: none"> <li>Distinguish between hypothesis driven and inquiry-based research.</li> <li>Recognize the flexibility of the discovery process and the scientific method.</li> <li>Analyze and solve a problem based upon information from the scientific/technical literature.</li> </ul>	<ul style="list-style-type: none"> <li>Scientific Method workshop and homework assignment</li> <li>Inquiry-based experiments</li> <li>(laboratory notebook)</li> <li>Pre-laboratory assignments</li> <li>Formal laboratory reports</li> </ul>
<ul style="list-style-type: none"> <li>Know the skills required to locate and understand scientific/technical literature.</li> </ul>	<ul style="list-style-type: none"> <li>Locate scientific or technical literature online and/or in the library</li> <li>Differentiate between factual scientific/technical literature and news/stories/opinions that are intended to persuade or entertain an audience</li> <li>Locate the definition of unknown vocabulary from a credible source and learn its meaning</li> <li>Explain an article from the secondary and tertiary scientific/technical literature</li> <li>Explain scientific/technical ideas in written or oral format</li> </ul>	<ul style="list-style-type: none"> <li>Scientific Literature workshop and homework assignment</li> <li>Formal laboratory reports</li> </ul>
<ul style="list-style-type: none"> <li>Understand the relationship between natural science and technology, the implications of scientific discoveries, and the potential of the STE disciplines to address problems of the contemporary world.</li> </ul>	<ul style="list-style-type: none"> <li>Give examples of how the STE disciplines are relevant and applicable to daily life.</li> <li>Recognize that as we gather scientific information, our view of the world changes.</li> <li>Explain how the application of STE disciplines requires ethical considerations and responsibilities.</li> <li>Appreciate that society has a vested interest in STE discoveries</li> </ul>	<ul style="list-style-type: none"> <li>Scientific Literature workshop and homework assignment</li> <li>Inquiry-based experiments</li> <li>Ethical considerations in the collection of data (laboratory notebook)</li> <li>Applications of chemistry (pre-laboratory assignments)</li> </ul>
<ul style="list-style-type: none"> <li>Understand the process of chemistry</li> </ul>	<ul style="list-style-type: none"> <li>Conduct an experiment and/or observe natural phenomena.</li> <li>Interpret data and/or observations.</li> <li>Draw conclusions from experimentation and/or observations.</li> </ul>	<ul style="list-style-type: none"> <li>Inquiry-based experiments</li> <li>(laboratory notebook)</li> <li>Pre-laboratory assignments</li> <li>Formal laboratory reports</li> </ul>
<ul style="list-style-type: none"> <li>Know how to present scientific results in a professional manner</li> </ul>	<ul style="list-style-type: none"> <li>Practice the collection and recording of empirical data in a laboratory notebook</li> <li>Organize recorded data in tables and graphs using Microsoft Excel</li> <li>Report data and conclusions in the appropriate language and format using Microsoft Word</li> </ul>	<ul style="list-style-type: none"> <li>Laboratory notebook</li> <li>Formal laboratory reports</li> </ul>

### **Assignments/Exams/Papers/Projects:**

Students will be evaluated in the following areas:

One “problem set” will be handed out on Thursday each two weeks, due the next Tuesday. Students must check blackboard to get them. The grade will be weighted as appears in the “evaluation” section, above. Any changes or other updates will be communicated verbally in class, and by email. All email communication will be between Suffolk accounts.

### **Grading/Evaluation:**

Attendance is mandatory and class participation will be encouraged. More than two unjustified absences will contribute negatively to the final grade by 10%.

The assigned homework presented by the student will be taken into account as positive if it is handed in on time. Such homework will not be accepted if submitted late. This work will be graded and contribute towards the final grade. Students must take all the tests, midterm and final exams.

The percentage of each part of the course to the final grade will be:

- Midterm exam: 20%
- Final exam: 40%
- Three quizzes: 20%
- Problem sets: 20%

If the students regularly arrive late, -5% will be taken away of the grade. If it happens consistently during all the course, it can make the student fail.

### **Participation/Attendance Policy:**

The SUMC Student Handbook states the following:

*Once a student is registered for a course, attendance at every meeting of every class is expected, including those held in the first week of the semester. A maximum of two unjustified absences is permitted. Each additional absence will cause the final course grade to be lowered by one-third of a letter grade, i.e., from A to A-; A- to B+; B+ to B, etc.*

*Excessive absences in a course will have a negative effect on the final grade. When a student is absent, the quality of his or her work in a course will deteriorate since material missed in class sessions can rarely be made up satisfactorily, even though the student remains responsible for that work.*

*Please note that even when a student has a justified reason for missing class, such as illness, the negative academic impact on learning will be the same as if the absence were for spurious reasons.*

*Any absence due to illness should be justified by a note from the student's physician or other health professional confirming the day(s) on which the student was unable to attend class. A written excuse from a student's host parent or residence supervisor is also acceptable.*

*In the event that a class meeting is unexpectedly cancelled, students will be expected to continue with readings or other assignments as originally scheduled. Any assignments due or class activities (e.g., a quiz, exam or presentation) planned for such a cancelled class are due at the next class meeting unless other instructions are communicated.*

Students are responsible for all material and assignments for the days missed, regardless of the reason for the absence.

The fact that a student is present in class does not alone contribute to the participation score. Participation and improvement in class is what makes up 10% of the grade.

### **Disability Statement:**

If you anticipate issues related to the format or requirements of this course, please meet with me. I would like us to discuss ways to ensure your full participation in my classroom.

If formal, disability-related accommodations are necessary, it is very important that you be registered with the Office of Disability Services (ODS) at the main Campus in Boston so that I am notified of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations. Check the ODS web site at [www.suffolk.edu/disability](http://www.suffolk.edu/disability) for information on accommodations.

### **Student Resources:**

SUMC provides a range of student services, both academic and personal. To learn more about course-related tutorials and academic workshops, refer to the SUMC Student Handbook, Section 2 "Academic Policies and Services". Section 5, "Living in Madrid", contains information on the medical and mental health resources, including an English-speaking therapist, available to you.

### **Midterm Review:**

At midterm, around week 6, you will be given a midterm grade based on your progress to date and performance on assignments, class participation and midterm exam. Midterm grades of C- or below will be reported to the Madrid Campus Academic Standing Committee, with an explanation of what I believe has contributed to that grade: excessive absences, poor time management or study skills, lack of effort, difficulty with the course material or with writing or language skills, etc. The Academic Standing Committee or I may contact you to suggest strategies for addressing these difficulties. I strongly encourage you to visit me during my office hours so we may discuss how you can be successful in this class.

### **Academic Misconduct:**

[www.suffolk.edu/about/mission-history/policies-procedures/academic-misconduct-policy](http://www.suffolk.edu/about/mission-history/policies-procedures/academic-misconduct-policy)

Suffolk University expects all students to be responsible individuals with high standards of conduct. Students are expected to practice ethical behavior in all learning environments and scenarios, including classrooms and laboratories, internships and practica, and study groups and academic teams. Cheating, plagiarism, unauthorized collaboration, use of unauthorized electronic devices, self-plagiarism, fabrication or falsification of data, and other types of academic misconduct are treated as serious offenses that initiate a formal process of inquiry, one that may lead to disciplinary sanctions.

Student work will be thoroughly examined for academic integrity and may be scanned using plagiarism detection software. A faculty member suspecting academic misconduct will contact the student using the Suffolk email address to schedule a meeting and will make all effort to do so within five business days of detecting the incident. During the meeting, the faculty member will present the documentation that led to suspected academic misconduct. Resolution of the incident will be according to the procedures outlined in the SUMC Student Handbook.

### **Academic Grievances Policy:**

[www.suffolk.edu/student-life/student-services/student-handbook/university-policies-for-student-cas-sbs/grievances-academics](http://www.suffolk.edu/student-life/student-services/student-handbook/university-policies-for-student-cas-sbs/grievances-academics)

**Course Schedule:**

The schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning.

<b>Weeks</b>	<b>General topic of lesson</b>	<b>Readings or other assignments due</b>
1-2	Introduction, Chapters 1 and 2	First problem set assigned.
3	Chapter 3	Submission of first problem set. Assignment of second problem set.
4	Chapter 4	Submission of second problem set. Assignment of third problem set.
5	Finish chapter 4	Return of third problem set.
5	Review session	
6	Oct 10: 1 <sup>st</sup> MT exam Oct 12: National holiday. No class	
7	Return of midterm exam, Chapter 5	Assignment of fourth problem set.
8	Finish Chapter 5. Chapter 6 up to Lewis structures.	Submission of fourth problem set and assignment of fifth problem set.
9	Finish Chapter 6. Chapter 7 Nov 01: No class. Holiday	Submission of fifth problem set. Assignment of sixth problem set.
10	Finish Chapter 7. Chapter 8	Submission of sixth problem set. Assignment of seventh problem set.
11	Finish Chapter 8. Chapter 9	Submission of sixth problem set. Assignment of and submission of seventh problem set.
12	Finish Chapter 9	Submission of seventh problem set.
13	Finish Chapter 9. Review session 1	
14	Review session 2	
<b>14</b>	<b>FINAL EXAM</b>	

<b>Chapter</b>	<b>Key Learning Outcomes</b>
1	<p><b>Atoms</b></p> <ul style="list-style-type: none"> <li>• <i>Classify matter by state and composition</i></li> <li>• <i>Distinguish between laws and theories</i></li> <li>• <i>Use atomic numbers, mass numbers, and isotope symbols</i></li> <li>• <i>Apply the law of definite proportions</i></li> <li>• <i>Apply the law of multiple proportions</i></li> <li>• <i>Calculate atomic mass</i></li> </ul>
2	<p><b>Measurement, Problem Solving, and the Mole Concept</b></p> <ul style="list-style-type: none"> <li>• <i>Report scientific measurements to the correct digit of uncertainty</i></li> <li>• <i>Use conversion factors</i></li> <li>• <i>Use the mole concept</i></li> <li>• <i>Calculate the density of a substance</i></li> <li>• <i>Solve problems involving equations</i></li> <li>• <i>Convert between moles and number of atoms</i></li> <li>• <i>Convert between mass and number of moles</i></li> </ul>

<b>Chapter</b>	<b>Key Learning Outcomes</b>
3	<p><b>The Quantum-Mechanical Model of the Atom</b></p> <ul style="list-style-type: none"> <li>• Relate wavelength, energy, and frequency to the electromagnetic spectrum</li> <li>• Use the de Broglie relation to calculate wavelength</li> <li>• Relate quantum numbers to one another and to their corresponding orbitals</li> <li>• Relate the wavelength of light to transitions in the hydrogen atom</li> <li>• Calculate the wavelength and frequency of light</li> <li>• Calculate the energy of a photon</li> </ul>
4	<p><b>Periodic Properties of the Elements</b></p> <ul style="list-style-type: none"> <li>• Distinguish between valence electrons and core electrons</li> <li>• Predict the charge of ions</li> <li>• Use periodic trends to predict atomic size</li> <li>• Use periodic trends to predict ion size</li> <li>• Use periodic trends to predict relative ionization energies</li> <li>• Predict metallic character based on periodic trends</li> <li>• Write electron configurations for atoms</li> <li>• Write orbital diagrams</li> <li>• Write electron configurations for ions</li> </ul>
5	<p><b>Molecules and Compounds</b></p> <ul style="list-style-type: none"> <li>• Use Lewis symbols to predict the chemical formula of an Ionic compound</li> <li>• Name ionic compounds</li> <li>• Name ionic compounds containing polyatomic ions</li> <li>• Name molecular compounds</li> <li>• Use formula mass to count molecules by weighing</li> <li>• Use mass percent composition as a conversion factor</li> <li>• Use chemical formulas as a conversion factors</li> <li>• Obtain an empirical formula from experimental data</li> <li>• Write molecular formulas</li> <li>• Write empirical formulas</li> <li>• Write formulas for ionic compounds</li> <li>• Calculate formula mass</li> <li>• Calculate mass percent composition</li> <li>• Calculate a molecular formula from an empirical formula and molar mass</li> <li>• Determine an empirical formula from combustion analysis</li> </ul>
6	<p><b>Chemical Bonding I: Drawing Lewis Structures and Determining Molecular</b></p> <ul style="list-style-type: none"> <li>• Classify bonds as pure covalent, polar covalent, or ionic</li> <li>• Assign formal charges</li> <li>• Use VSEPR theory to predict the basic shapes of molecules</li> <li>• Predict molecular geometries using VSEPR theory and the effects of lone pairs</li> <li>• Predict the shapes of larger molecules</li> <li>• Use molecular shape to determine polarity of a molecule</li> <li>• Write Lewis structures for covalent compounds</li> <li>• Write Lewis structures for polyatomic ions</li> <li>• Write resonance Lewis structures</li> <li>• Assess competing resonance structures</li> <li>• Write Lewis structures for compounds having expanded octets</li> </ul>
7	<p><b>Chemical Bonding II: Valence Bond Theory and Molecular Orbital Theory</b></p> <ul style="list-style-type: none"> <li>• Predict bond order in a homonuclear diatomic molecule</li> <li>• Write hybridization and bonding schemes using valence bond theory</li> </ul>

<b>Chapter</b>	<b>Key Learning Outcomes</b>
8	<p><b>Chemical Reactions and Chemical Quantities</b></p> <ul style="list-style-type: none"> <li>• Balance chemical equations</li> <li>• Use the stoichiometry of a reaction as a conversion factor</li> <li>• Write equations for combustion reactions</li> <li>• Determine the limiting reactant</li> <li>• Calculate theoretical yield</li> <li>• Calculate percent yield</li> </ul>
9	<p><b>Introduction to Solutions and Aqueous Reactions</b></p> <ul style="list-style-type: none"> <li>• Use molarity as a conversion factor</li> <li>• Use solution stoichiometry to find volumes and amounts</li> <li>• Predict compound solubility</li> <li>• Name acids</li> <li>• Assign oxidation states</li> <li>• Calculate molarity</li> <li>• Determine solution dilutions</li> <li>• Write equations for precipitation reactions</li> <li>• Write complete ionic equations</li> <li>• Write net ionic equations</li> <li>• Write equations for acid-base reactions</li> </ul>

### **CHEM L111 M1 - LABORATORY SESSIONS**

**Text:** Notebook given by the teacher before each lab session. Handout for the experiment will be given to the students prior to the lab session.

#### **Grading:**

Lab reports: 75%

Lab notebook: 25%

#### **Lab safety:**

Safety rules in the lab will be given at the beginning of the course. Every student is expected to follow all these rules while working in the lab. Especially important is to wear goggles at all time during lab sessions. Accidents or individual or medical problems must be notified the instructor.

#### **Care of equipment:**

All laboratory equipment, particularly delicate equipment like the analytical balance, must be handled with care. Students who deliberately mishandle lab equipment will be penalized with a lower grade for the course.

#### **Lab notebooks:**

Each student must maintain a laboratory notebook. Loose leaf notebooks are not acceptable. Keep a table of contents on the first page. During the lab session all observations and data are to be recorded clearly and in order in the notebook. Each student must have his or her lab notebook signed by the instructor at the end of each lab session. The notebook grade is 10% of the total grade.

#### **Attendance:**

Attendance in each lab session is mandatory. Each student must sign the attendance sheet for each lab session. A missed lab will be recuperated only due to a forced reason.

#### **Pre-lab assignments:**

A pre-lab assignment is part of the report for all labs. It is due at the pre-lab lecture on the first day the lab is to be performed.

#### **Lab reports:**

Lab reports are due on the day of the next lab session after the lab is completed. Hand the reports directly to me or put them in my mailbox in Viña 3.

Students who turn in two lab reports late without an excuse, will receive a grade reduced by one-third of a grade level, e.g. A to A-. If three lab reports are handed in late, the grade will be reduced by two-thirds of a grade, e.g. A to B+, and so forth. One excused lab will be made up during the make-up session at the end of the term. A grade of zero will be given for more than one excused labs/missing reports at the end of term.

**LABORATORY Schedule:**

The schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning.

Weeks	Experiment	Prelab Readings from Laboratory Manual and Textbook	Assignment Due
1	No Lab		
2	Check-in; Safety in the Laboratory; Significant Figures In-Class Workshop	<b>Manual:</b> Introduction I. Program Components; II. Safety in the Chemical Laboratory (p. 1-3)  Packet handed out in class	Hand in assignment before leaving class
3	Scientific Method Workshop	Excerpt from Harwood, "A New Model for Inquiry- Is the Scientific Method Dead?"  Packet handed out in class  <b>Textbook:</b> Ch 1 Atoms, Section 1.3 The Scientific Approach to Knowledge	Signed safety agreement  Hand in assignment before leaving class
4	Physical Properties: The Glass Bead Lab	<b>Manual:</b> Introduction, III. Instruments for Chemical Measurement A. Handling Chemicals, B. Measurement by Mass; V. Quantitative Interpretation of Chemical Measurements B. Uncertainty Analysis (p. 1-4, 18-22)  Methods of Inquiry and Measurement: Physical and Chemical Properties, The Glass Bead Lab (p. 28-33)  <b>Textbook:</b> Ch 2 Measurement, Problem Solving, and the Mole Concept; Section 2.2 The Reliability of a Measurement; Section 2.3 Density	Scientific Method homework assignment  Outline of experiment and prelab assignment
5	Scientific Literature Workshop	Packet handed out in class	Glass Bead report due  Read Scientific Literature Workshop handout, p. 1-7  Hand in assignment before leaving class
6	<b>No Lab Session - MIDTERM EXAM PERIOD</b>		
7	Use of Volumetric Glassware: The Floating Egg Problem	<b>Manual:</b> Introduction, III. Instruments for Chemical Measurement C. Measurement by Volume (p. 3-6)  Measurement of Chemical Ratios: Float an Egg, Experiment 1: Use of Volumetric Glassware (p. 41-48)	3 Articles homework assignment  Outline of experiment and prelab assignment

<b>Weeks</b>	<b>Experiment</b>	<b>Prelab Readings from Laboratory Manual and Textbook</b>	<b>Assignment Due</b>
<b>8</b>	Stoichiometry experiment: The synthesis of Alum	<b>Manual:</b> To be handed out  <b>Textbook:</b> Ch 9 Introduction to Solutions and Aqueous Reactions; Section 9.2 Solution Concentration; Section 9.3 Solution Stoichiometry	Outline of experiment and prelab assignment
<b>9</b>	The Gas Laws: A Study of the Behaviors of Gases	<b>Manual:</b> Gases, Skill-Building Lab: The Gas Laws, Parts I, II, III, IV (p. 128-136)  <b>Textbook:</b> Ch 11 Gases; Section 11.2 Pressure; Section 11.3 The Simple Gas Laws; Section 11.6 Mixtures of Gases and Partial Pressures (*Collecting Gases Over Water)	Report for Spectrophotometry of Dyes  Outline of experiment and prelab assignment
<b>10</b>	Modeling Workshop	Packet handed out in class  <b>Textbook:</b> Ch 6 Chemical Bonding I: Drawing Lewis Structures and Determining Molecular Shapes	Report for Gas Laws  Prelab assignment from packet  Hand in worksheets before leaving class
<b>11</b>	Mass Stoichiometry: Synthesis of Metal Complexes	<b>Manual:</b> Introduction, Section V A. Chemical Reaction Stoichiometry; (p. 15-18)  Mass Stoichiometry, Skill-Building Lab: Synthesis of Metal Complexes (p. 55-62)  <b>Textbook:</b> Ch 8 Chemical Reactions and Chemical Quantities; Section 8.4 Reaction Stoichiometry; Section 8.5 Limiting Reactant, Theoretical Yield, and Percent Yield	Outline of experiment and prelab assignment
<b>12</b>	Make-up session and checkout		Report for Synthesis of Metal Complexes